

<b>Institution:</b> University of South Wales		
<b>Unit of Assessment:</b> B11 Computer Science & Informatics		
<b>Title of case study:</b> Enhancing public policy delivery through the application of GIS network-based accessibility techniques		
<b>Period when the underpinning research was undertaken:</b> 2006-20		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Mitch Langford (ML)	Associate Professor (ML)	2003-2020 (ML); 2000-2020 (GH)
Gary Higgs (GH)	Professor (GH)	
<b>Period when the claimed impact occurred:</b> 2014-2020		
<b>Is this case study continued from a case study submitted in 2014? No</b>		
<p><b>1. Summary of the impact</b> (indicative maximum 100 words)</p> <p>Since 2006, researchers at the University of South Wales (USW) have conducted research that examines geographical variations in accessibility to a range of public and private services. This research has <b>1)</b> supported activities of the Welsh Government, providing the evidential base that guided the selection of areas used to pilot their new childcare provision policy <b>2)</b> prompted an on-going evaluation into the use of these tools for calculating future Welsh Index of Multiple Deprivation scores used to allocate programme funds across Wales <b>3)</b> supplied National Sports Bodies such as Welsh Gymnastics, and the charitable organisation Tenovus Cancer Care, previously unobtainable levels of detail on revealed patterns of accessibility to current and future configurations of service delivery points.</p>		
<p><b>2. Underpinning research</b> (indicative maximum 500 words)</p> <p>Since 2006, research conducted at the University of South Wales (USW) has focussed on enhancing small area accessibility estimation models in order to examine geographical variation in a range of public and private services. This was driven by a need to understand spatial and social inequalities in the provision of essential services and suggest ways in which this can be more accurately measured and monitored. From 2010, this has involved the incorporation of transport barriers and service competition initially using proprietary (ArcGIS™) and latterly open source (QGIS, PostGIS) Geographical Information System (GIS) tools. Building on research originally concerned with varying the types of demand- and supply-side measures used within accessibility models, we conducted sensitivity analysis on the implications of using alternative approaches based around dasymetric population estimation models (<b>R1</b>). Much of this research was funded by the Economic and Social Research Council (ESRC) under Phase 1 (2009-2013) of the Wales Institute of Socio-economic Research Data and Methods (WISERD) initiative: a multi-university, cross-disciplinary institute involving Aberystwyth, Bangor, Cardiff, South Wales and Swansea universities. Researchers in USW have developed innovative GIS approaches to aid further understanding of spatial variations in the social and economic geography of Wales. Initially this involved the application of accessibility models to a wide range of facility types, such as post offices, health facilities and public libraries, to examine the impacts of changes in network configuration at the national level since 2010 (<b>R2</b>).</p> <p>Current models are traditionally based on assumptions of access to private transport – our research has for the first-time created techniques to also consider public transit systems leading to multi-modal approaches to determining access (<b>R3</b>). Utilising public web services reporting transport timetables across the UK, this research has extended ‘floating catchment area’ (FCA) methodology based on gravity model approaches to consider the implications of calculating access to facilities using enhancements to ‘traditional’ FCA approaches. Subsequently, research funded by Sport Wales in 2015, involved incorporating such enhancements within bespoke Add-In tools developed for ESRI’s ArcGIS™ Desktop GIS. This has been used by both the Welsh Government and Sports Governing Bodies in Wales to gather evidence regarding the most appropriate places to allocate funding to sporting infrastructure. Follow-up funded research commissioned by the Welsh Government in 2017 updated findings with a new database of sport facilities collected on behalf of Sport Wales</p>		

which enabled a longitudinal study of changing patterns in provision. The use of these tools has been subsequently extended to consider primary health care services, allowing a multi-modal examination of spatial variations in access to GP practices (**R4**).

Research conducted in the Second Phase of the ESRC-funded WISERD Civil Society (2015-2019) initiative investigated the potential for incorporating extensions to the basic FCA approach to measure spatial accessibility within UK government policy-relevant indices of deprivation (using the Welsh Index of Multiple Deprivation (WIMD) as a case study). The WIMD is the official measure of deprivation used to rank Lower Super Output Areas (LSOAs) according to their relative deprivation levels, across eight types of deprivation to produce an overall index. It is used to inform policymaking, allocate resources, and plan levels of service provision at local level and is updated every four to five years. Our research, in relation to the 2014 version of WIMD, contributed to on-going methodological debates surrounding its construction and has demonstrated how adopting alternative computational approaches might impact on those communities identified as the 'most deprived' (**R5**). This in turn has implications for place-based funding mechanisms targeted at particular areas. The models developed permit the inclusion of potentially more sophisticated approaches to measuring access to services than those currently adopted which rely on simple proximity or service density approaches (**R5**). In another applied study, research was funded in 2017 by the Care and Social Services Inspectorate Wales (CSSIW) in relation to a Welsh Government 'flagship policy' regarding free childcare. This applied USW-developed accessibility tools and models to provide enhanced insights into the existing availability of childcare services. Previously very little was known about detailed geographical patterns of childcare provision in Wales. Our research accounted for supply-side factors (such as total opening hours of centres), and demand (the distribution of working families with children in the appropriate age groups), and both were moderated by the impacts of distance. We investigated variations in childcare capacity across Wales in relation to the Welsh Government pledge (2017) to provide 30 hours-a-week free early education and childcare for working parents of three and four-year-olds (**R6**). To understand patterns in the availability and accessibility of existing childcare capacity in Wales, detailed modelling was undertaken to create, for the first time, maps revealing childcare provision at highly detailed spatial scales (**R6**).

Most recently these models have been extended to operate in open-source GIS environments, initially through a Knowledge Economy Skills Scholarship (KESS) PhD studentship with Tenovus Cancer Care (2016-2019) and subsequently a similarly funded studentship with Sport Wales (2018-2021). These projects have led to the further development of tools and support materials to measure geographical accessibility to cancer screening and support services using QGIS/PostGIS. It also resulted in the analysis of recreational opportunities within a client-server architecture that allows both model building and results dissemination to take place remotely via a web browser interface.

### 3. References to the research (indicative maximum of six references)

**(R1)** LANGFORD, M. and HIGGS, G. (2006) 'Measuring Potential Access to Primary Healthcare Services: The Influence of Alternative Spatial Representations of Population', *The Professional Geographer*, 58(3), 294-306.

**(R2)** LANGFORD, M. and HIGGS, G. (2010) 'Accessibility and public service provision: Evaluating the impacts of the Post Office Network Change Programme in the UK', *Transactions of the Institute of British Geographers*, 35(4), 585-501.

*ESRC Funded (WISERD, Phase 1)*

**\*(R3)** LANGFORD, M., FRY, R. and HIGGS, G. (2012) 'Measuring transit system accessibility using a modified two-step floating catchment technique', *International Journal of Geographical Information Science*, 26(2), 193-214.

*ESRC Funded (WISERD, Phase 1)*

**\*(R4)** LANGFORD, M., HIGGS, G. and FRY, R. (2016) 'Multi-modal Two-Step Floating Catchment Area Analysis of Primary Health Care Accessibility', *Health and Place*, 38, 70-81. *ESRC funded (WISERD Phase 2: Civil Society), Inter-disciplinary research with a health geographer based in Swansea University*

**\*(R5)** PAGE, N., LANGFORD, M. and HIGGS, G. (2019) 'Measuring spatial accessibility to services within indices of multiple deprivation: implications of applying an enhanced two-step floating catchment area approach', *Applied Spatial Analysis and Policy*, 12(2), 321-348. *ESRC funded (WISERD Phase 2: Civil Society)*

**(R6)** LANGFORD, M., HIGGS, G. and DALLIMORE, D. (2019) 'Investigating spatial variations in access to childcare provision using network-based GIS models', *Social Policy and Administration*, 53(5), 661-677.

*Welsh Government funded, Inter-disciplinary research with a sociologist based at Bangor University*

#### **Selection of Relevant Research Funding, with grant values as awarded to University of South Wales (previously Glamorgan)**

Wales Institute of Social and Economic Data and Methods (WISERD), Phase 1 funded by HEFCW and ESRC (HEFCW Reconfiguration and Collaboration Fund; £3.4 million; **ESRC** Methods Programme; £1.46 million); Grant Reference: **RES-576-25-0021** 2009-2011

Data usability. 3-year PhD project (£59,000) – funded by **Ordnance Survey** 2013-2016

Wales Institute of Social and Economic Data and Methods (WISERD) Civil Society, funded by **ESRC** Large Centres Grant; £7 million; Grant Reference: **ES/L009099/1** 2014-2019

Accessibility models to provide a better understanding of the current availability of childcare services, funded by the Care and Social Services Inspectorate Wales (CSSIW) for the **Welsh Government**, £5000, 2017-2018

Wales Institute for Economic Research, Data & Methods (WISERD), Civil Society, Civic Stratification and Civil repair, funded by **ESRC** Large Centres Grant; £8m of funding from the Economic and Social Research Council (ESRC) and a further £4.6m of funding from its partner Universities; Grant Reference: **ES/S012435/1** 2019-2024

#### **4. Details of the impact** (indicative maximum 750 words).

Through the application of network-based GIS tools developed by USW researchers, policy officers within the Welsh Government, Welsh Gymnastics, Sport Wales and Tenovus Cancer Care have been able to strategically plan their activities to better support the delivery of the services they provide. The following projects have been funded by the ESRC through WISERD unless otherwise stated:

##### **USW research informed the Welsh Governments' policy on Childcare Offer for Wales.**

**R6** informed the decision-making process regarding the implementation of the policy and guided the selection of initial pilot areas. Findings that were obtained using our modelling were published in a Welsh Government report that mapped childcare supply across Wales in relation to potential demand by calculating the number of children (aged under 4) within a reasonable travel distance of registered childcare settings against mid-year population estimates (**S1**). This provided the Welsh Government with a sound evidential base for childcare policy making in Wales – for example where the research identified insufficient childcare, this was used by the Welsh Government to evaluate whether parents are able to easily find suitable local childcare (**S2**). This also gained widespread public interest and media attention in Wales; for example, it was featured on the BBC News Website in November 2017 (**S3**). The Head of Policy Analysis for the Childcare Offer in the Welsh Government (**S4**) stated that GIS-based analyses: *"have been of value to Welsh Government in providing a real contribution to the evidence base for childcare policy making in Wales. The identification of areas across Wales which have a lack of childcare supply against potential demand has enabled Welsh Government to focus some of the early implementation areas of the childcare offer for Wales to test whether this is experienced by parents on the ground. In participating areas where there this work has identified insufficient childcare; Welsh Government will evaluate whether parents are able to easily find suitable local childcare. The work has raised further research questions for the childcare policy team to consider in terms of what drives this mismatch in supply and demand and whether stimulation of the sector is required to increase childcare capacity in those areas. The maps have been useful to present to*

*stakeholders in gaining recognition of the variance in childcare supply across Wales and the subsequent issues the Childcare Offer for Wales may face during implementation.”*

**Policy discussions around accessibility to sporting facilities in Wales were influenced by USW research.**

Software tools developed by USW researchers have been used by National Sporting Bodies such as Welsh Gymnastics/Gymnasteg Cymru since 2015 (**S5**). This is the national governing body for gymnastics with a membership of over 20,000 and with 97 affiliated clubs caters to 60000 7-16 years old participating in gymnastics in Wales. The use of our GIS tools has provided greater insight into current and projected levels of provision and enabled them to assemble a detailed evidence base upon which to base policy implementation at localised scales. As a result of our accessibility research, such bodies are now using information regarding spatial patterns of provision in gymnastics facilities to inform their facilities management strategy. They also have used it to better understand social inequalities in access amongst population groups that traditionally have had poor levels of engagement in recreational activities. Presentations have been made in 2018 and 2019 to the Governing Body of Welsh Gymnastics based on our accessibility research. This enabled them to understand the use of facilities and current gaps in provision for those social groups, including ethnic minority communities in urban areas of Wales, at a perceived disadvantage in accessing gymnastic facilities as well as for those ‘elite’ athletes aiming to participate in international sporting events such as the Commonwealth Games. Sport Wales, the national body responsible for developing and promoting sport and physical activity in Wales and the main adviser to the Welsh Government on sport, used (and continues to use) this tool to help decide where public sector funding should be invested to deliver the greatest benefit to local communities (**S6**). As these tools become more widely available, there is also the potential for further collaboration between organisations charged with promoting sports participation and those concerned with health.

**USW research influenced public policy debate on the use of alternative approaches to incorporate accessibility within the Welsh Index of Multiple Deprivation.**

The methods we developed on our research using WIMD (**R5**) were included in consultation documents published by the Welsh Government (WG) that considered alternative approaches to updating the 2019 version of WIMD (**S7**). The Social Justice Statistician with responsibility for the construction of the WIMD (**S8**) said that this *“research prompted debate about the role of alternative supply-demand network-based GIS approaches amongst Welsh Government officials and others in the Access to Services Domain expert group in the lead up to the implementation of WIMD 2019. The published journal paper and a presentation from the WISERD team to the expert group led to a wider appreciation of the impact of adopting such models within the WIMD methodology.”* Our research has shown how different transportation modes can be incorporated into FCA based accessibility models using a wider range of services. The Social Justice Statistician (**S8**) added that based on these refinements of the approach for assessing service accessibility *“there was strong support for continuing to explore this method for potential use in future indices, including the production of a parallel set of outputs using the 2SFCA method following WIMD 2019. WG officials responsible for producing WIMD are keen to continue working with the WISERD team on the above, to enable us to assess the implications of adopting an alternative approach on future Access to Services domain data for future editions of WIMD. The potential impact of this would be better quality data for the Access to Services domain of WIMD, through service access figures that takes into consideration the geographical distribution of all supply sites found within a reasonable travel time/distance. WIMD has a wide range of uses across many sectors to inform research, service provision and funding.”*

**USW research provided valuable insight to policies geared to optimising local provision of cancer care services in the Welsh community.**

This study commenced in October 2016 and has developed open source tools and support materials to measure geographical accessibility to screening and cancer support services in Wales. Previously, Tenovus Cancer Care, a cancer charity that supports cancer patients and



their families and the biggest Wales-based funder of cancer research with a staff of around 200 and over 2000 volunteers, had not considered GIS approaches to optimise the locations of their cancer services. Our models have enabled important insights into how their two Mobile Treatment Units can best be used to support the capacity already provided at fixed locations where patients receive treatment. This allowed the research team in Tenovus Cancer Care to investigate the impact of alternative spatial configurations of cancer services to enable more patients to be treated closer to home. This creates maximum reach and impact as well as alleviates the pressure of travel for those who must journey to and from a cancer treatment facility. The Director of Research and Support at Tenovus Cancer Care (**S9**) stated that: *“With the numbers of people being diagnosed with cancer and so requiring treatment rising year on year, the work conducted, particularly the GIS maps produced, are giving us some really important insights into how the Tenovus Mobile Treatment Units can be used to help alleviate capacity in fixed locations where people receive treatment.”*

#### **5. Sources to corroborate the impact** (indicative maximum of 10 references)

##### **USW research informed the Welsh Governments’ policy on Childcare Offer for Wales:**

**S1:** Government Social Research publication, *Childcare Capacity in Wales: Mapping childcare supply against potential demand* (Social Research Number 65/2107) has been published on the Welsh Government (Statistics and Research) web-site. **See Page 24; section 3.**

<https://gov.wales/childcare-capacity-wales-mapping-childcare-supply-against-potential-demand-0>

**S2:** The importance of this research was highlighted in the evidence paper to the Children, Young People and Education Committee of the National Assembly for Wales on 18<sup>th</sup> April 2018 (CYPE(5)-11-18)

<https://business.senedd.wales/documents/s74068/CYPE5-11-18%20-%20Paper%201%20-%20Welsh%20Government%20Childcare%20Offer%20for%20Wales.pdf>

**S3:** Featured on BBC news coverage and BBC website.

<http://www.bbc.co.uk/news/uk-wales-politics-41833226>

**S4:** Testimonial from the Principal Social Researcher and Head of Policy Analysis for the Childcare Offer in Welsh Government (27/7/2017)

##### **Policy discussions around accessibility to sporting facilities in Wales were influenced by USW research:**

**S5:** Evidence of the value of this research has been provided by Dr Jonathan Radcliffe, *Senior Data and GIS Officer* at Sport Wales in the article ‘*Improving Access to Sporting Facilities in Wales*’ published on the ESRI UK web-site which describes project findings

<https://resource.esriuk.com/esri-resources/sport-wales/>

**S6:** Digital Transformation for Government Case Study (p.6: **Making Data Work**):

<https://resource.esriuk.com/esriuk-ebooks/digital-transformation-for-government/>

##### **USW research influenced public policy debate on the use of alternative approaches to incorporate accessibility within the Welsh Index of Multiple Deprivation:**

**S7:** A Welsh Government consultation document prepared in the lead-up to the release of the 2019 version of the Index of Multiple Deprivation – the official measure of relative deprivation - includes reference to this research and proposals to consider adopting our approach in index construction (**see section 5.3.3**).

<https://beta.gov.wales/proposed-indicators-welsh-index-multiple-deprivation-2019>

**S8:** Testimonial from the Social Justice Statistician, Knowledge and Analytical Services, Welsh Government, (05/11/2020)

##### **USW research provided valuable insight to policies geared to optimising local provision of cancer care services in the Welsh community:**

**S9:** Testimonial from Director of Research and Support, Tenovus Cancer Care (13/11/2018)